

Appl. No. 10/070,013  
Amdt. dated February 23, 2005  
Reply to Office Action of August 25, 2004

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Amendments to the Claims:

This listing of claims will replace all prior versions, and listings of claims in the application:

Listing of Claims:

1. (Currently amended) A radio frequency (RF) up-converter with reduced local oscillator leakage, ~~for modulating~~ emulating the modulation of an input signal  $x(t)$  with a local oscillator signal having frequency  $f$ , said up-converter comprising:

a synthesizer for generating mixing signals  $\phi_1$  and  $\phi_2$  which vary irregularly over time, where:

$\phi_1 * \phi_2$  has significant power at the frequency  $f$  of a said local oscillator signal being emulated, ~~and;~~

neither  $\phi_1$  nor  $\phi_2$  has significant power at the frequency  $f$  of said local oscillator signal being emulated, ~~and;~~

said mixing signals  $\phi_1$  and  $\phi_2$  are designed to emulate said local oscillator signal having frequency  $f$  in a time domain analysis;

a first mixer coupled to said synthesizer for mixing said input signal  $x(t)$  with said mixing signal  $\phi_1$  to generate an output signal  $x(t) \phi_1$ ; and

a second mixer coupled to said synthesizer and to the output of said first mixer for mixing said signal  $x(t) \phi_1$  with said mixing signal  $\phi_2$  to generate an output signal  $x(t) \phi_1 \phi_2$ , said output signal  $x(t) \phi_1 \phi_2$  emulating the modulation of said input signal  $x(t)$  with said local oscillator signal having frequency  $f$ .

2. (Previously presented) The radio frequency (RF) up-converter of claim 1 wherein said synthesizer further comprises:

a synthesizer for generating mixing signals  $\phi_1$  and  $\phi_2$ , where  $\phi_1 * \phi_1 * \phi_2$  does not have a significant amount of power within the bandwidth of said output signal  $x(t) \phi_1 \phi_2$ .

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3. (Previously presented) The radio frequency (RF) up-converter of claim ~~2~~ 1 wherein said synthesizer further comprises:

a synthesizer for generating mixing signals  $\phi_1$  and  $\phi_2$ , where  $\phi_1 * \phi_2$  does not have a significant amount of power within the bandwidth of said output signal  $x(t)$   $\phi_1 \phi_2$ .

4. (Original) The converter of claim 3, further comprising:  
a closed loop error correction circuit.

5. (Previously presented) The radio frequency (RF) up-converter of claim 4, wherein said closed loop error correction circuit further comprises:  
an error level measurement circuit for measuring an error in said output signal  $x(t)$   $\phi_1 \phi_2$ ; and  
a time-varying signal modification circuit for modifying a parameter of one of said mixing signals  $\phi_1 \phi_2$  to minimize said error level.

6. (Original) The radio frequency (RF) up-converter of claim 5, wherein said error level measurement circuit comprises a power measurement.

7. (Original) The radio frequency (RF) up-converter of claim 5, wherein said error level measurement circuit comprises a voltage measurement.

8. (Original) The radio frequency (RF) up-converter of claim 5, wherein said error level measurement circuit comprises a current measurement.

9. (Previously presented) The radio frequency (RF) up-converter of claim 5, wherein said modified parameter is the phase delay of one of said mixing signals  $\phi_1$  and  $\phi_2$ .

10. (Previously presented) The radio frequency (RF) up-converter of claim 5, wherein said modified parameter is the fall or rise time of one of said mixing signals  $\phi_1$  and  $\phi_2$ .

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11. (Previously presented) The radio frequency (RF) up-convertor of claim 5, wherein said modified parameter includes both the phase delay and the fall or rise time of one of said mixing signals  $\phi_1$  and  $\phi_2$ .

12. (Previously presented) The radio frequency (RF) up-convertor of claim 3 wherein said synthesizer further comprises:

a synthesizer for generating mixing signals  $\phi_1$  and  $\phi_2$ , where said mixing signals  $\phi_1$  and  $\phi_2$  can change with time in order to reduce errors.

13. (Original) The radio frequency (RF) up-convertor of claim 3, further comprising:

a DC offset correction circuit.

14. (Original) The radio frequency (RF) up-convertor of claim 13, wherein said DC offset correction circuit comprises:

a DC offset generating circuit for generating a DC offset voltage;

a summer for adding said DC offset voltage to an output of one of said mixers;

and

a DC error level measurement circuit for modifying the level of said DC offset voltage to minimize error level.

15. (Original) The radio frequency (RF) up-convertor of claim 14, wherein said DC error level measurement circuit comprises a power measurement circuit.

16. (Original) The radio frequency (RF) up-convertor of claim 14, wherein said DC error level measurement circuit comprises a voltage measurement circuit.

17. (Original) The radio frequency (RF) up-convertor of claim 14, wherein said DC error level measurement circuit comprises a current measurement circuit.

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18. (Original) The radio frequency (RF) up-converter of claim 1, further comprising: a filter for removing unwanted signal components.

19. (Original) The radio frequency (RF) up-converter of claim 18, where said filter comprises:

a filter for removing unwanted signal components from said  $x(t)$   $\phi_1$  signal.

20. (Currently amended) The radio frequency (RF) up-converter of claim 1, wherein said mixing signals  $\phi_1$  and  $\phi_2$  are random is a square wave.

21. (Currently amended) The radio frequency (RF) up-converter of claim 1, wherein said mixing signals  $\phi_1$  and  $\phi_2$  ~~are pseudo-random~~ effect the modulation of an in-phase component of said input signal  $x(t)$ , and a complementary up-converter with mixing signals 90 degrees out of phase, is used to effect the modulation of a quadrature component of said input signal  $x(t)$ .

22. (Previously presented) The radio frequency (RF) up-converter of claim 1, wherein said synthesizer uses a single time base to generate both mixing signals  $\phi_1$  and  $\phi_2$ .

23. (Previously presented) The radio frequency (RF) up-converter of claim 1, wherein said mixing signals  $\phi_1$  and  $\phi_2$  are digital waveforms.

24. (Previously presented) The radio frequency (RF) up-converter of claim 1, wherein said mixing signals  $\phi_1$  and  $\phi_2$  are square waveforms.

25. (Original) The radio frequency (RF) up-converter of claim 3, further comprising:

a local oscillator coupled to said synthesizer for providing a periodic signal having a frequency that is an integral multiple of the frequency of said local oscillator signal being emulated.

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26. (Original) The radio frequency (RF) up-converter of claim 4, wherein said closed loop error correction circuit comprises a digital signal processor (DSP).

27. (Original) The radio frequency (RF) up-converter of claim 4, wherein said closed loop error correction circuit comprises analogue components.

28. (Previously presented) The radio frequency (RF) up-converter of claim 4, wherein said closed loop error correction circuit further comprises:  
an error level measurement circuit for measuring an error in said output signal  $x(t)$   
 $\phi_1$ ; and  
a time-varying signal modification circuit for modifying a parameter of one of said mixing signals  $\phi_1$  and  $\phi_2$  to minimize said error level.

29. (Previously presented) The radio frequency (RF) up-converter of claim 1, where said synthesizer uses different patterns to generate signals  $\phi_1$  and  $\phi_2$ .

30. Canceled.

31. (Currently amended) A method of modulating a baseband signal  $x(t)$  comprising the steps of:  
generating mixing signals  $\phi_1$  and  $\phi_2$  which vary irregularly over time, where:  
 $\phi_1 * \phi_2$  has significant power at the frequency  $f$  of a local oscillator signal being emulated; and  
neither  $\phi_1$  nor  $\phi_2$  has significant power at the frequency  $f$  of said local oscillator signal being emulated; and  
said mixing signals  $\phi_1$  and  $\phi_2$  are designed to emulate said local oscillator signal having frequency  $f$  in a time domain analysis;  
mixing said input signal  $x(t)$  with said mixing signal  $\phi_1$  to generate an output signal  $x(t)$   $\phi_1$ ; and

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mixing said signal  $x(t)$   $\phi_1$  with said mixing signal  $\phi_2$  to generate an output signal  $x(t) \phi_1 \phi_2$ .

32. (Currently amended) An integrated circuit comprising the radio frequency (RF) up-converter of ~~any one of claims 1--29~~ claim 1.

33-34. Canceled.